Claims:

1. A method of producing propylene from ethane comprising the steps of:

a. steam cracking an ethane or primarily ethane feedstock thereby producing a cracking product containing ethylene, hydrogen, ethane, methane, acetylene and C_3 and heavier hydrocarbons;

b. treating said cracking product in an ethylene plant recovery section including removing said hydrogen, methane and C_3 and heavier hydrocarbons therefrom and converting said acetylene therein primarily to ethylene to thereby produce a treated cracking product containing primarily ethylene and ethane and including fractionating said treated cracking product in a C_2 fractionator and obtaining an ethylene fraction and a bottoms ethane fraction;

c. recycling said bottoms ethane fraction to said steam cracking;

d. reacting by dimerization in a dimerization section a first portion of said ethylene fraction thereby producing a butene-rich stream;

e. reacting by metathesis in a metathesis section the butene in said butene-rich stream with a second portion of said ethylene fraction thereby producing a propylene-rich stream; and

f. separating product propylene from said propylene-rich stream.

2. A method as recited in claim 1 wherein said propylene-rich stream produced in said metathesis section contains ethylene and ethane and wherein said ethylene and ethane are removed from said propylene-rich stream in a metathesis section deethanizer.

3. A method as recited in claim 2 wherein a portion of said ethylene and ethane from said metathesis section deethanizer is condensed and returned to said metathesis section deethanizer as reflux.

4. A method as recited in claim 2 wherein a first portion of said ethylene and ethane removed from said propylene-rich stream is recycled to said metathesis section and a second portion is purged and recycled to said ethylene plant recovery section.

5. A method as recited in claim 4 wherein said second portion is recycled to said C_2 fractionator.

6. A method as recited in claim 2 wherein said butene-rich stream produced in said dimerization section contains ethylene and ethane and wherein said ethylene and ethane are removed from said butene-rich stream in a dimerization section deethanizer.

7. A method as recited in claim 6 wherein a first portion of said ethylene and ethane removed from said butene-rich stream is recycled to said dimerization section and a second portion is purged and recycled to said ethylene plant recovery section.

8. A method as recited in claim 7 wherein said second portion is recycled to said C_2 fractionator.

9. A method as recited in claim 6 wherein said deethanized butene-rich stream contains heavier hydrocarbons and wherein said heavier hydrocarbons are separated from said butene in a butene separator.

10. A method as recited in claim 2 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled to said ethylene plant recovery section.

11. A method as recited in claim 10 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled directly to said C_2 fractionator.

12. A method as recited in claim 11 wherein a portion of said ethylene fraction from said C_2 fractionator is fed to said metathesis section deethanizer as reflux.

13. A method as recited in claim 11 wherein said butene-rich stream in said dimerization section contains heavier hydrocarbons and ethylene and ethane and wherein said heavier hydrocarbons are separated in a butene separator from said butene-rich stream and the remaining butene-rich stream containing said ethylene and ethane together with said butene are fed to said metathesis section.

14. A method as recited in claim 13 wherein the deethanized propylene-rich stream contains butene and other C_4 and heavier hydrocarbons and wherein said butene and other C_4 and heavier

hydrocarbons are separated therefrom and fed to said butene separator in said dimerization section.

15. A method as recited in claim 1 wherein said ethylene fraction is chemical grade ethylene containing ethane and having an ethylene content less than 99% by volume.

16. A method as recited in claim 15 wherein a portion of said ethylene and ethane from said metathesis section deethanizer is condensed and returned to said metathesis section deethanizer as reflux.

17. A method as recited in claim 16 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled to said ethylene plant recovery section.

18. A method as recited in claim 17 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled directly to said C_2 fractionator.

19. A method as recited in claim 18 wherein a portion of said ethylene fraction from said C_2 fractionator is fed to said metathesis section deethanizer as reflux.

20. A method as recited in claim 18 wherein said butene-rich stream produced in said dimerization section contains heavier hydrocarbons and ethylene and ethane and wherein said heavier hydrocarbons are separated in a butene separator from said butene-rich stream and the remaining butene-rich stream containing said ethylene and ethane together with said butene are fed to said metathesis section.

21. A method as recited in claim 20 wherein the deethanized propylene-rich stream contains butene and other C_4 and heavier hydrocarbons and wherein said butene and other C_4 and heavier hydrocarbons are separated therefrom and fed to said butene separator.

22. A method as recited in claim 15 wherein an additional ethylene fraction is obtained in said step of fractionating said treated cracking product and wherein said additional ethylene fraction is a polymer grade ethylene product having an ethylene content greater than 99% by volume.

23. A method as recited in claim 22 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled to said ethylene plant recovery section.

24. A method as recited in claim 23 wherein a portion of said ethylene and ethane from said metathesis section deethanizer is condensed and returned to said metathesis section deethanizer as reflux.

25. A method as recited in claim 23 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled to said C_2 fractionator.

26. A method as recited in claim 25 wherein a portion of said ethylene fraction from said C_2 fractionator is fed to said metathesis section deethanizer as reflux.

27. A method as recited in claim 25 wherein said butene-rich stream produced in said dimerization section contains heavier hydrocarbons and ethylene and ethane and wherein said heavier hydrocarbons are separated in a butene separator from said butene-rich stream and the remaining butene-rich stream containing said ethylene and ethane together with said butene are fed to said metathesis section.

28. A method as recited in claim 27 wherein the deethanized propylene-rich stream contains butene and other C_4 and heavier hydrocarbons and wherein said butene and other C_4 and heavier hydrocarbons are separated therefrom and fed to said butene separator in said dimerization section.

29. A method as recited in claim 1 wherein said ethane or primarily ethane feedstock comprises a mixed ethane/propane feedstock containing at least 70% ethane.

30. A method of producing propylene from a hydrocarbon feedstock comprising the steps of:

a. steam cracking said hydrocarbon feedstock thereby producing a cracking product containing ethylene, hydrogen, ethane, methane, acetylene and C_3 and heavier hydrocarbons;

b. treating said cracking product in an ethylene plant recovery section including removing said hydrogen, methane and C_3 and heavier hydrocarbons therefrom and converting said acetylene therein to ethylene to thereby produce a treated cracking product containing primarily ethylene and ethane and

including fractionating said treated cracking product in a C_2 fractionator and obtaining a chemical grade ethylene fraction having an ethylene content less than 99% by volume and a bottoms ethane fraction;

c. recycling said bottoms ethane fraction to said steam cracking;

d. reacting said chemical grade ethylene fraction by metathesis in a metathesis section with butene thereby producing a propylene-rich stream containing ethylene and ethane;

e. removing said ethylene and ethane from said propylene-rich stream in a metathesis section deethanizer; and

f. recycling said removed ethylene and ethane to said ethylene plant recovery section.

31. A method as recited in claim 30 wherein said removed ethylene and ethane are recycled directly to said C_2 fractionator.

32. A method as recited in claim 30 wherein a portion of said ethylene and ethane from said metathesis section deethanizer is condensed and returned to said metathesis section deethanizer as reflux.

33. A method as recited in claim 30 wherein a portion of said ethylene fraction from said C_2 fractionator is fed to said metathesis section deethanizer as reflux.

34. A method per claim 30 where additional propylene product is obtained from the unsaturated C_3's produced in the steam cracker.

35. A method as recited in claim 30 wherein an additional ethylene fraction is obtained in said step of fractionating said treated cracking product and wherein said additional ethylene fraction is a polymer grade ethylene product having an ethylene content greater than 99% by volume.

36. A method as recited in claim 35 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled to said ethylene plant recovery section.

37. A method as recited in claim 36 wherein a portion of said ethylene and ethane from said metathesis section deethanizer is condensed and returned to said metathesis section deethanizer as reflux.

38. A method as recited in claim 36 wherein said ethylene and ethane removed from said propylene-rich stream in said metathesis section deethanizer are recycled directly to said C_2 fractionator.

39. A method as recited in claim 38 wherein a portion of said ethylene fraction from said C_2 fractionator is fed to said metathesis section deethanizer as reflux.

40. A method as recited in claim 30 wherein said butene for reaction in said metathesis section comprises butene recovered from said heavier hydrocarbons in said cracking product.

41. A method as recited in claim 30 wherein said butene for reaction in said metathesis section comprises butene from a source selected from refinery processes and the catalytic dehydrogenation of butanes.